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Assessment of the Redfish in NAFO Division 30

by

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Abstract

In 1987 Canada took only 181 t of a reported catch of just over 11,000 t. Catches by the Soviet Union accounted for over 60% of the total, while Cuba took about 25%. Catch rates continue to fluctuate from one year to the next and there are no significant trends over time. The TAC was lowered from 20,000 t in 1987 to 14,000 t in 1988 and available data from the 1987 fishery are insufficient to suggest any change in this for 1989.

Résumé

En 1987, la part des prises du Canada n'a été que de 181 t sur des prises déclarées de plus de 11 000 t. Les prises par les Russes représentaient plus de 60 % des prises totales, tandis que les prises par Cuba correspondaient à environ 25 %. Les taux de capture continuent de fluctuer d'une année à l'autre et aucune tendance importante ne se manifeste au cours des années. Le TPA est passé de 20 000 t en 1987 à 14 000 t en 1988, et les données accessibles provenant de l'exploitation de 1987 ne nous permettent pas de proposer aucune modification de cette valeur pour 1989.

105-04597/

Introduction

Between 1976 and 1987, nominal catches ranged from about 7000 t to 18,000 t (Table 1) and have been above 20,000 t in only two years (Figure 1). In 1987, provisional statistics indicate a catch of about 11,000 t. The Soviet Union continues to predominate in the fishery (taking over 60% of the total in 1987), while Canada's catch remains low (only 181 t in 1987). The fishery has taken place predominantly in the second half of the year during recent times, although there is some fishing activity in most months (Table 2). The first TAC of 16,000 t was imposed in 1974. This level was increased to 20,000 t in 1978 and maintained through 1986 (with the exception to 1980 when it was raised, for reasons unknown, to 21,900 t). During the 1987 assessment meetings, it was recommended that the TAC be lowered to 14,000 t based on $^2/_3$ effort MSY (from general production analyses) (Atkinson and Power MS 1987), and this new level has been adopted for 1988. Since the imposition of TAC's in 1974, they have never been achieved.

Methods and Results

As in the past, catch and effort data from ICNAF/NAFO Statistical Bulletins (1959-1985) were combined with preliminary NAFO data (1986) and preliminary Canadian data (1987). Only data where redfish comprised >50% of the total catch were used. Previously (eg. Atkinson and Power MS 1987), data from side and stern trawlers were summarily combined (both for bottom trawls and midwater trawls). For this assessment, the data were re-extracted and the side and stern categories kept separate. For some of the earlier years, it was not clear from the ICNAF statistics whether catches were by side or stern trawlers. For these, classification was achieved by back-checking with the lists of fishing vessels (compiled by ICNAF) and/or Lloyd's Registry. Classification of charter vessels (not identified as side or stern in NAFO statistics) was done through examination of Foreign Observer Program (FOP) data.

The extracted catch and effort data were input into a multiplicative model (Gavaris 1980) to derive a standardized catch rate series. Those country-gear-TC and months with less than 5 data points were deleted as were all catches and effort of less than 10 units in order to eliminate potential biases. In addition, because there were only 2 data points for 1987 (Canadian), they were eliminated from the analysis. Examination of the residuals from an initial run did not indicate any bad outliers in the data (Figures 2a and b), so no points were deleted.

In the past, questions have been raised concerning the validity of grouping similar category types *a posteriori* but since the data were considered "new", a comparison of categories within the country-gear-TC (CGT) and month category types was carried out. Although the relationship between categories was generally the same as that in the past (Atkinson and Power MS 1987), there were a few minor differences (Table 3). These new groupings were used in the subsequent analysis. As with the previous analysis (Atkinson and Power MS 1987), weighting of the regression was not carried out because the extent of possible pro-rating of the effort data prior to 1984 is not known. It should be noted that the standard CGT was changed from Canadian vessels (as used in the past) to the USSR-OTB2-TC7.

The analysis of variance (Tables 4a and b) for the final run indicates that the model accounts for about 62% of the variation. The final residual plots are shown in Figures 3a and b. Boxplots of the residuals (Figure 4) do not reveal any trends with time. Each of the category types is significant (Table 4b) but the year category is significant only because of two years, 1979 and 1982. Thus the catch rates, although showing a high amount of inter-annual fluctuation, indicate no overall trend with time for the period 1959 to 1986 (Figure 5, Table 5). Effort has been fairly stable in the recent period (Figure 6, Table 5), although there has been a general decline since the mid- to late- 1970's. There are no effort data available for 1968. The higher standardized catch rates (and related lowering of standardized effort) above those given previously (Atkinson and Power MS 1987) is directly attributable to the change in the standard CGT noted above. The USSR standard had a higher coefficient than did the standard Canadian vessels in previous analyses.

Previous assessments have paid little to no attention to the variance surrounding the estimates of catch rate from the multiplicative analysis. This current assessment indicates that there has been considerable variation in the catch rates from year to year but no significant trend exists over the time period for which effort data are available. It is therefore not appropriate to utilize general production models for this stock at present.

Stratified random research surveys have been conducted in Division 3O from 1973 to the present. Although these surveys routinely only fish depths less than 200 fathoms (366 m), there are some data available for redfish. The length frequencies (Figure 7) suggest that there may have been two pulses of recruitment during the period of the surveys; one (or two) in the early-mid 1970's, and one in the late 1970's-early 1980's. Year classes from these periods correspond approximately to those found to be relatively strong in other areas.

Some commercial frequencies are available from the 1987 fishery (Figure 8). These indicate fish of about 17-30 cm being taken although the modes are generally in the 20-23 cm range except in one case (Japan in March).

Conclusions

Examination of the limited research data available suggests that there may have been two pulses of recruitment to the fishery in recent years. One of these may be reflected in an increase in commercial catch rates in the late 1970's. If the later pulse is real, it should be reflected in increased catch rates in the next few years. Catch rates show considerable fluctuations over the 1959-1987 time period but trends are not present. It is felt that the stock is being (and has been) haervested below the $F_{0.1}$ level but the data are insufficient to confirm this. If this is the case, then higher catches are possible.

References

Atkinson, D.B. and D. Power. MS 1987. Redfish in NAFO Division 3O. CAFSAC Res. Doc. 87/44.

Gavaris, S. 1980. Use of a multiplicative model to estimate catch rate and effort from commercial data. Can. J. Fish. Aquat. Sci. 37: 2272-2275.

Table 1: Nominal catches (t) of redfish in Division 3O by country and year.

Country	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986*	1987*
Canada (M)+	610	655	381	1,557	565	417	47	4	29	48	3	24
Canada (N)	3,054	2,317	1,460	4,847	976	2,160	444	3	138	56	134	159
France (M)	1	-	-	-	-	-	-	-	-	-	-	-
France (SP)	15	2	-	-	-	-	-	-	-	-	-	-
France	-	-	-	-	-	-	-	2	-	-	-	-
Japan	4	-	3	2	-	-	496	1	1,258	661	1,162	1,073
Portugal	1	-	-	134	59	-	5	-	-	-	-	-
Romania	-	-	-	664	-	-	-	-	-	-	-	-
Spain	-	-	1	8	-	-	-	-	25	630	45	32
USSR	11,663	7,376	4,647	8,008	14,219	8,659	8,717	5,670	7,262	5,905	6,099	7,089
Cuba	-	500	368	2,517	1,487	1,368	1,651	1,460	1,316	806	3,006	2,859
USA	-	-	-	-	-	-	-	-	-	104	2	-
TOTAL	15,348	10,850	6,860	17,737	17,306	12,604	11,360	7,140	10,028	8,210	10,451	11,236

* Provisional.

\+ Maritimes and Quebec were combined prior to 1979.

Table 2: Nominal catches (t) of redfish in Division 3O by month and year.

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1976	352	452	399	857	1,477	1,497	3,119	1,440	2,221	2,540	40	954	15,348
1977	553	36	1,047	1,736	987	1,865	1,580	1,113	1,032	828	63	10	10,850
1978	48	102	1,478	1,326	1,216	930	656	353	433	155	158	5	6,860
1979	35	844	2,464	2,072	87	1,997	739	692	1,235	1,320	3,594	2,658	17,737
1980	612	1,250	856	3,698	1,145	858	143	2,395	1,860	149	986	3,354	17,306
1981	991	3,735	1,444	1,601	621	1,467	773	584	510	873	5	-	12,604
1982	-	1	1,121	1,258	545	652	4,555	2,245	661	233	89	-	11,360
1983	254	355	2,904	1,227	71	156	576	938	319	1	73	266	7,140
1984	219	155	2	32	85	257	446	3,210	2,799	1,882	435	506	10,028
1985	1,522	-	453	239	118	252	227	1,710	1,486	350	35	1,817	8,210 a
1986*	707	-	425	593	68	710	3,491	3,712	58	3	317	367	10,451
1987*	-	5	760	6	763	14	910	259	347	234	1,222	392	11,236 b

a includes 1 t caught by USA in unknown month
b includes 6,324 t caught in unknown months
* Provisional.

Table 3: Comparison of similarities of categories in country-gear-TC (CGT) and month category types between the 1987 assessment and that presented in this paper (number is code shown in Table 4b).

1987 Assessment CGT	This Assessment CGT	Code	1987 Assessment Month	This Assessment Month	Code
FR(SP) OTB 4	FR(SP) OTB 4	9114	April	April	4
USSR OTB 4	USSR OTB 4	20114	January	January	1
			February	October	
CAN(M) OTB 4			October	November	
			November	December	
CAN(N) OTB 4	CAN(N) OTB 4				
CAN(MQ) OTB 4	CAN(MQ) OTB 4	2114	March	March	3
CAN(MQ) OTB 5	CAN(MQ) OTB 5		May		
CAN(M) OTB 5	CAN(M) OTB 5		July	May	5
	CAN(N) OTB 5		June		
CAN(N) OTB 5			August	June	8
	JPN OTB 6	14126	September	August	
JPN OTB 6	POL OTB 7				
				July	7
POL OTB 7				September	
	JPN OTB 7	20127			
JPN OTB 7	USSR OTB 7			February	2
CUBA OTM 7					
USSR OTB 7	CUBA OTM 7	4157			
CUBA OTB 7	CUBA OTB 7	4127			
USSR OTM 7	USSR OTM 7				

Table 4a: ANOVA from final multiplicative analysis of commercial catch and effort data for redfish in NAFO Division 3O.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... 0.790
MULTIPLE R SQUARED..... 0.623

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	1.061E1	1.061E1	
REGRESSION	38	1.187E2	3.124E0	15.373
TYPE 1	6	5.379E1	8.965E0	44.118
TYPE 2	6	1.081E1	1.802E0	8.870
TYPE 4	26	1.497E1	5.759E-1	2.834
RESIDUALS	353	7.173E1	2.032E-1	
TOTAL	392	2.010E2		

Table 4b: Coefficients for the different categories from the final multiplicative analysis of commercial catch and effort data for redfish in NAFO Division 3O.

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	20127	INTERCEPT	0.693	0.142	392
2	8				
4	59				
1	2114	1	-0.787	0.064	155
	4127	2	0.152	0.075	60
	4157	3	-0.174	0.136	15
	9114	4	-1.628	0.227	5
	14126	5	-0.352	0.123	18
	20114	6	-1.489	0.145	14
2	1	7	-0.342	0.070	100
	2	8	-0.421	0.128	16
	3	9	-0.276	0.102	29
	4	10	-0.650	0.106	25
	5	11	-0.195	0.096	32
	7	12	-0.119	0.068	103
4	60	13	0.077	0.290	3
	61	14	0.176	0.213	7
	62	15	0.018	0.184	12
	63	16	0.058	0.186	13
	64	17	-0.103	0.227	6
	65	18	-0.350	0.249	5
	66	19	-0.019	0.349	2
	67	20	0.344	0.213	7
	69	21	-0.371	0.199	9
	70	22	-0.225	0.192	10
	71	23	0.101	0.179	14
	72	24	-0.249	0.168	17
	73	25	0.069	0.201	9
	74	26	-0.388	0.198	9
	75	27	-0.385	0.224	6
	76	28	0.050	0.157	23
	77	29	-0.050	0.158	23
	78	30	-0.099	0.156	24
	79	31	0.315	0.153	29
	80	32	0.167	0.155	26
	81	33	0.288	0.158	23
	82	34	0.376	0.160	24
	83	35	0.228	0.172	17
	84	36	0.228	0.160	24
	85	37	0.051	0.166	20
	86	38	0.087	0.176	17

Table 5: Catch rate and effort derived from final multiplicative analysis of commercial catch and effort data for redfish in NAFO Division 3O.

PREDICTED CATCH RATE

STANDARDS USED VARIABLE NUMBERS: 20127 8

YEAR	LN TRANSFORM MEAN	LN TRANSFORM S.E.	RETRANSFORMED MEAN	RETRANSFORMED S.E.	CATCH	EFFORT
1959	0.6928	0.0200	2.192	0.309	9268	4229
1960	0.7697	0.0734	2.304	0.614	5030	2183
1961	0.8690	0.0343	2.595	0.477	11394	4390
1962	0.7105	0.0245	2.226	0.347	7557	3395
1963	0.7510	0.0254	2.317	0.367	9194	3969
1964	0.5898	0.0413	1.956	0.394	20232	10343
1965	0.3433	0.0513	1.521	0.341	22438	14750
1966	0.6735	0.1087	2.056	0.661	15305	7443
1967	1.0365	0.0360	3.066	0.577	19037	6209
1969	0.3220	0.0274	1.507	0.248	15878	10536
1970	0.4681	0.0254	1.746	0.277	13192	7556
1971	0.7935	0.0193	2.425	0.336	19792	8162
1972	0.4437	0.0157	1.712	0.214	16117	9414
1973	0.7619	0.0235	2.344	0.357	8797	3752
1974	0.3044	0.0258	1.482	0.237	13124	8856
1975	0.3075	0.0377	1.478	0.285	15110	10225
1976	0.7430	0.0123	2.313	0.256	15348	6634
1977	0.6425	0.0131	2.091	0.239	10850	5188
1978	0.5936	0.0132	1.991	0.228	6860	3445
1979	1.0073	0.0121	3.014	0.331	17737	5885
1980	0.8602	0.0117	2.602	0.281	17306	6652
1981	0.9811	0.0126	2.935	0.329	12604	4294
1982	1.0683	0.0116	3.204	0.345	11360	3546
1983	0.9208	0.0155	2.759	0.343	7140	2588
1984	0.9206	0.0128	2.762	0.312	10028	3630
1985	0.7435	0.0147	2.312	0.279	8210	3551
1986	0.7800	0.0177	2.394	0.318	7637	3190

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.156

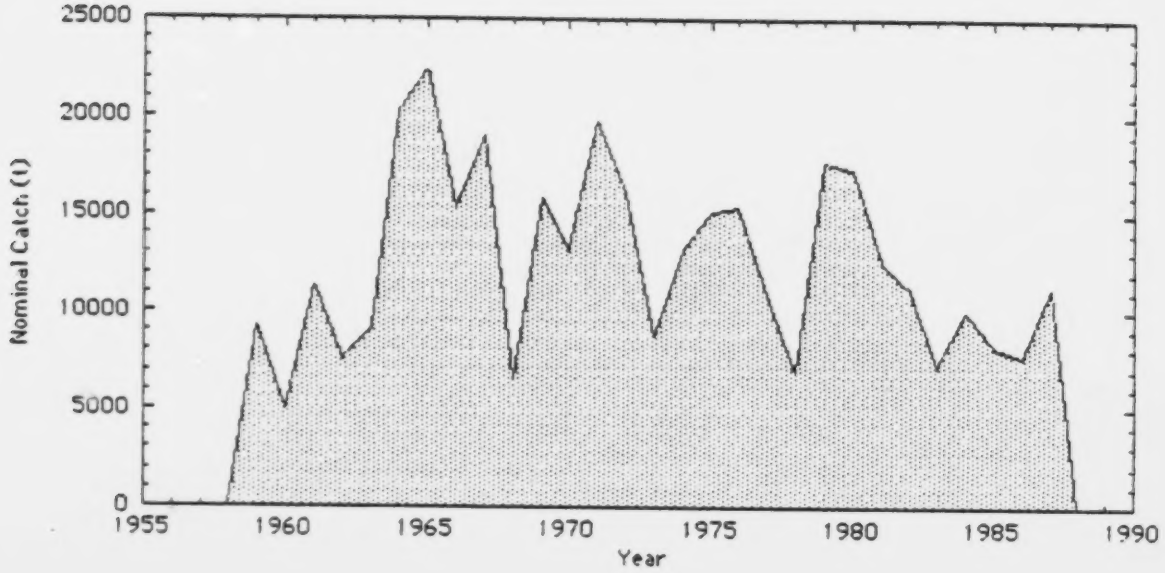

Figure 1. Nominal Catches (t) of redfish in NAFO Division 3O, 1959-1987 (1986 and 1987 are provisional).

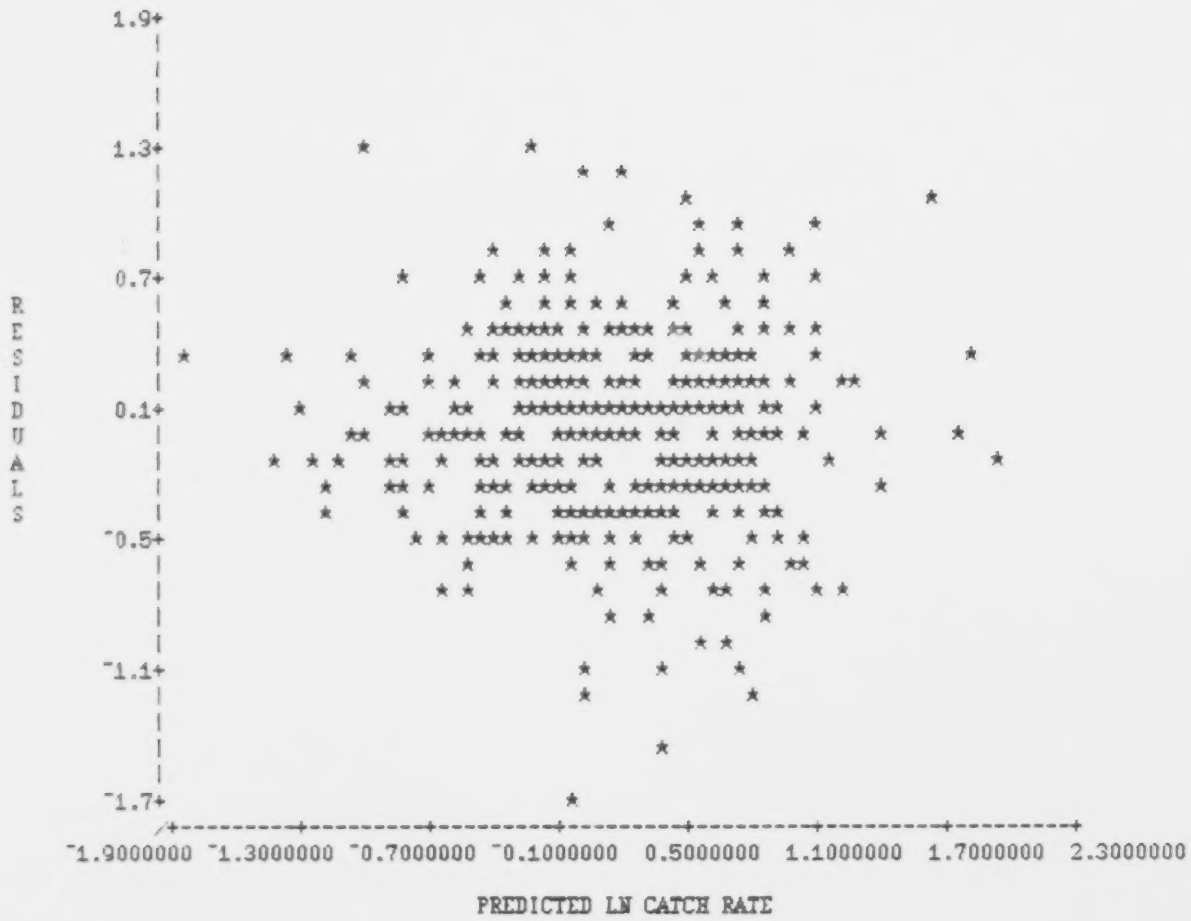

Figure 2a: Residuals vs predicted ln catch rate from initial multiplicative analysis of commercial catch and effort data for redfish in NAFO Division 3O.

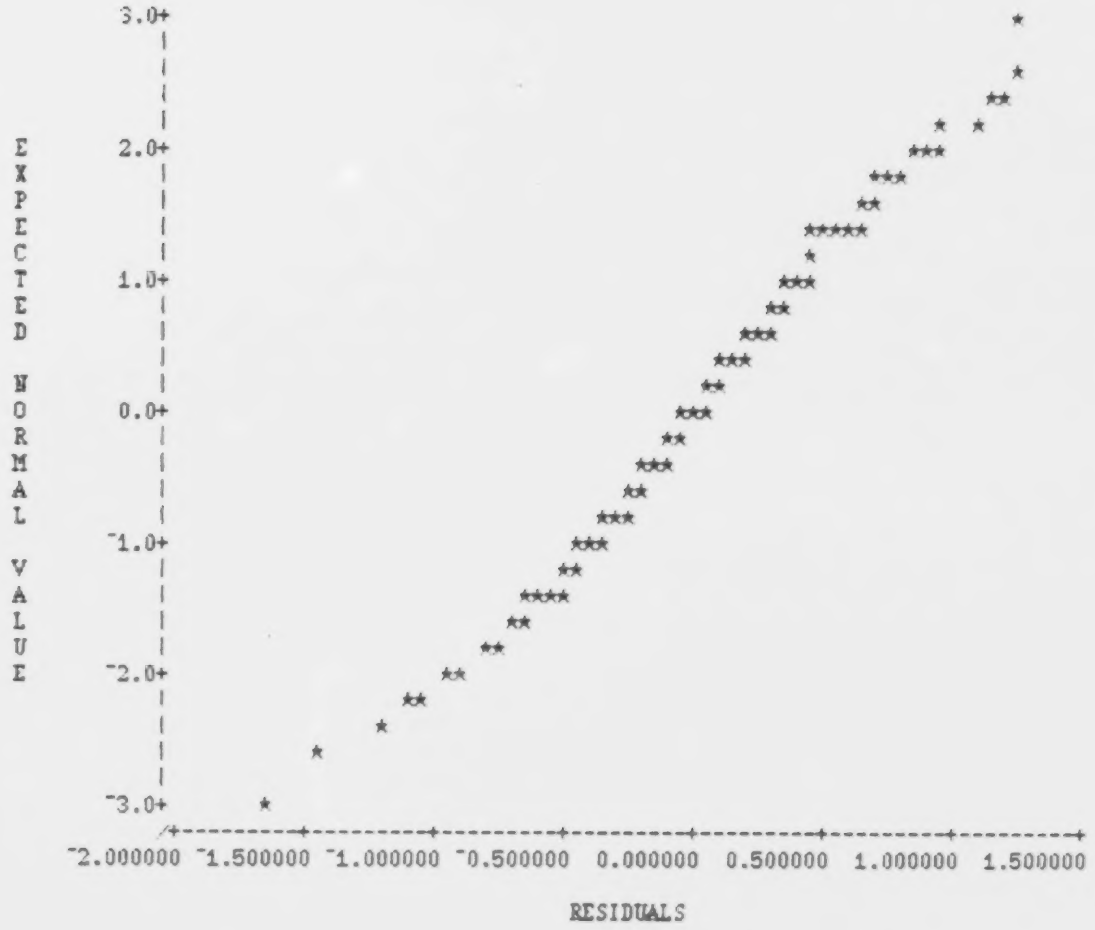

Figure 2b: Expected normal values vs residuals from initial multiplicative analysis of commercial catch and effort data for redfish in NAFO Division 3O.

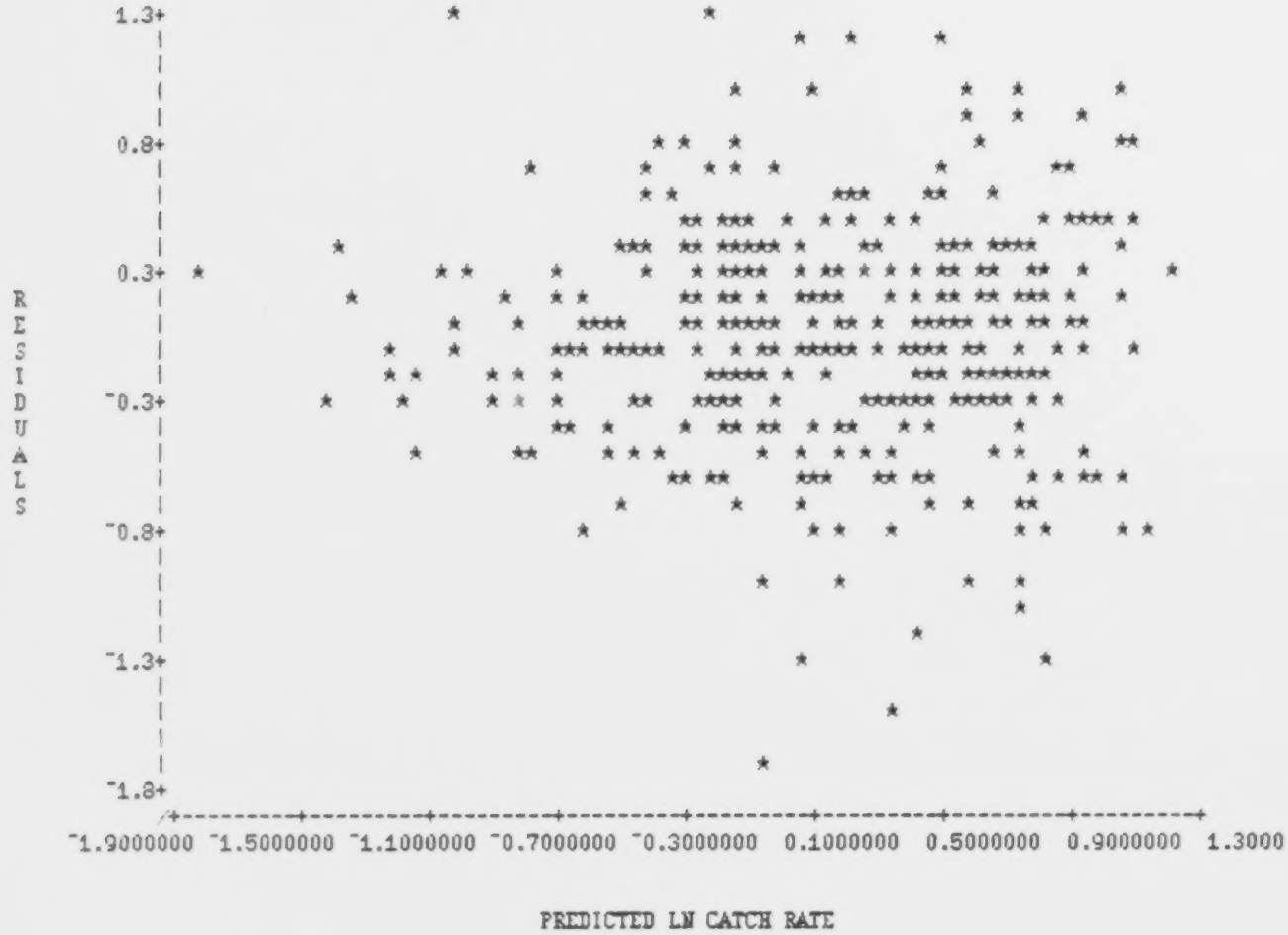

Figure 3a: Residuals vs predicted ln catch rate from final multiplicative analysis of commercial catch and effort data for redfish in NAFO Division 3O.

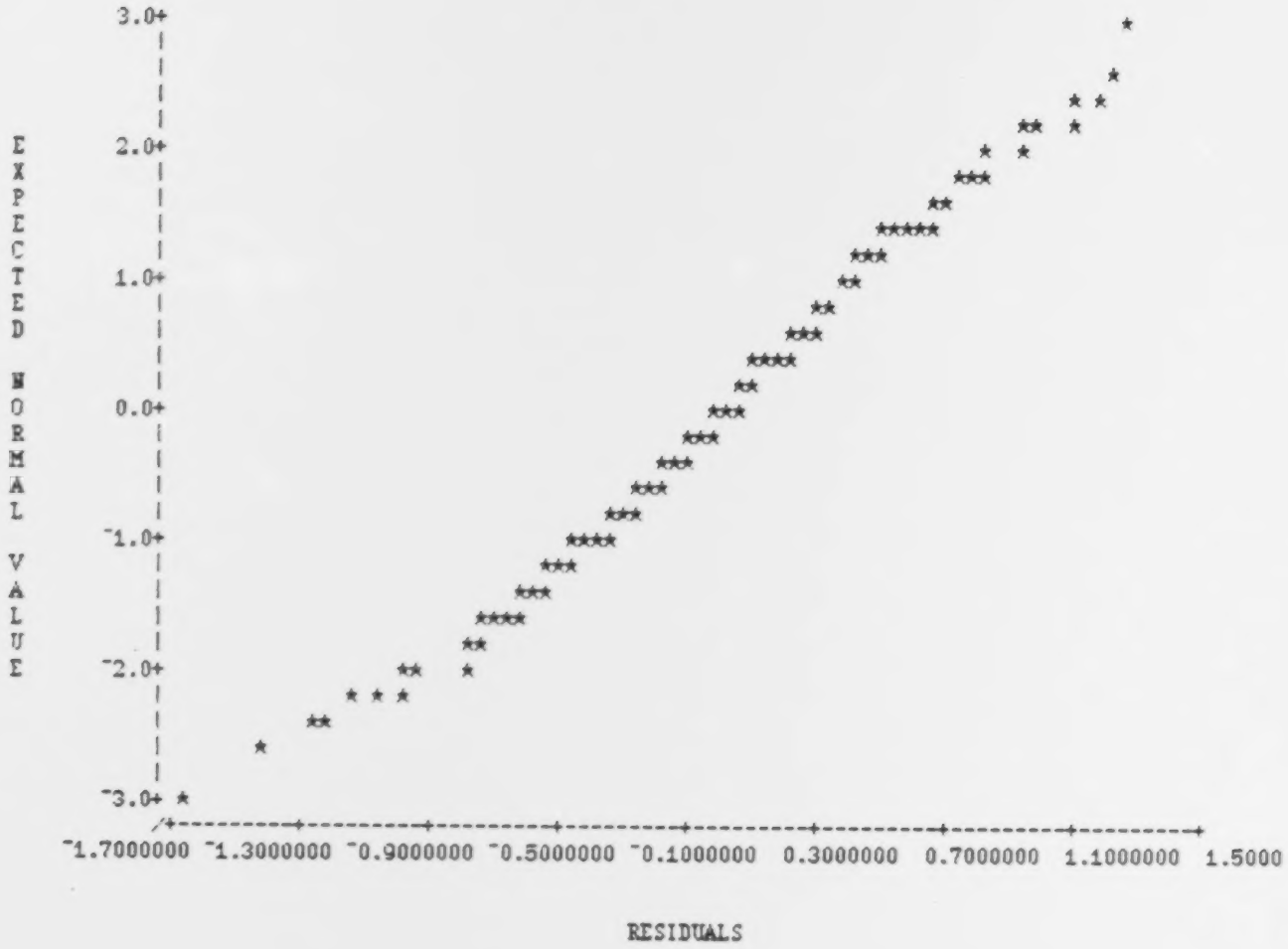

Figure 3b: Expected normal values vs residuals from final multiplicative analysis of commercial catch and effort data for redfish in NAFO Division 3O.

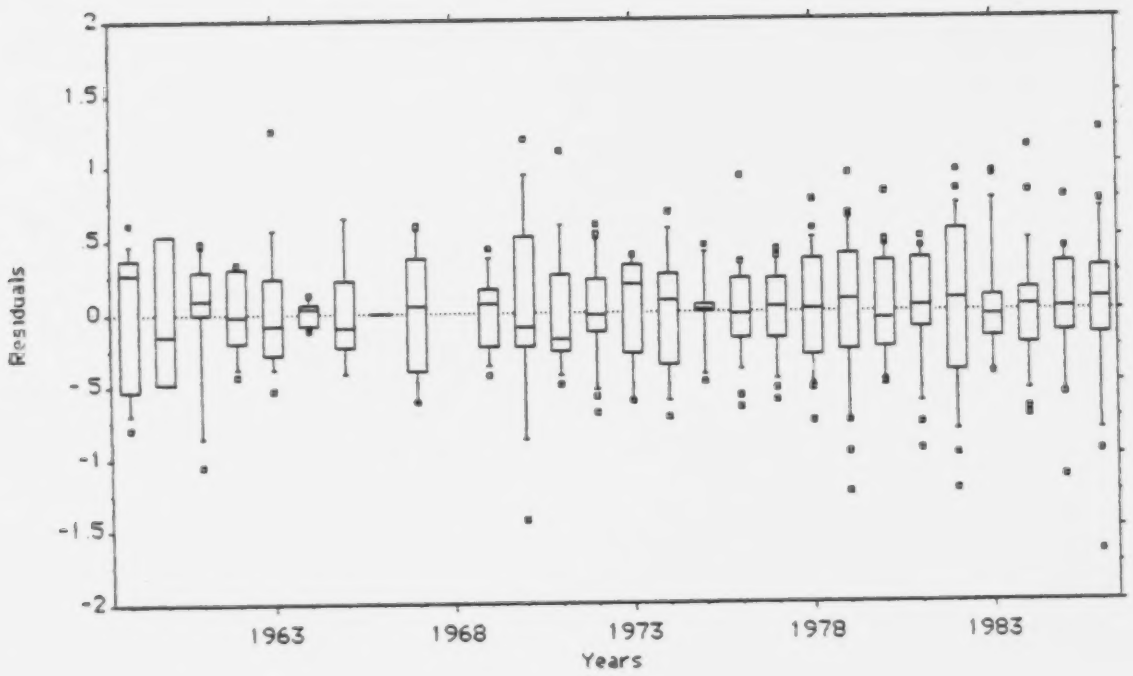

Figure 4: Boxplots (percentiles) of residuals derived from the final multiplicative analysis of the commercial catch and effort data for redfish in NAFO Division 3O.

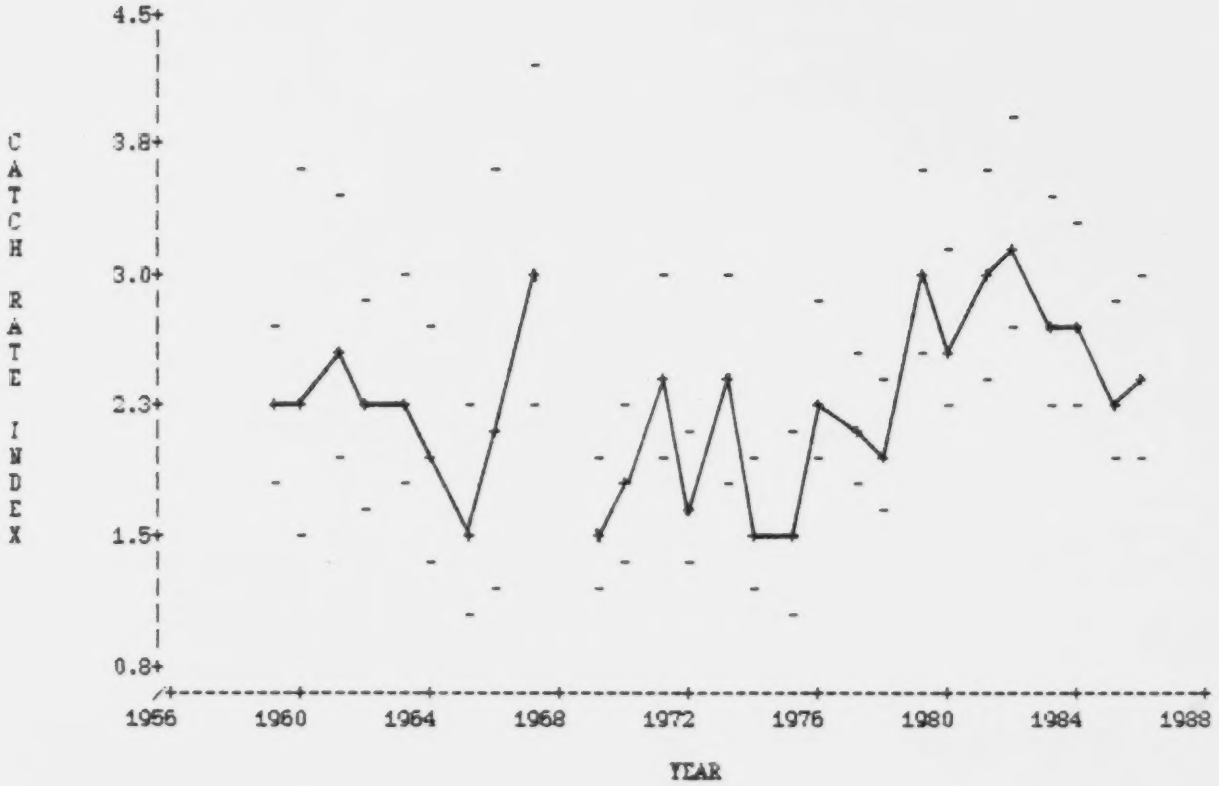

Figure 5: Standardized catch rates (t/hr) derived from the final multiplicative analysis of the commercial catch and effort data for redfish in NAFO Division 3O.

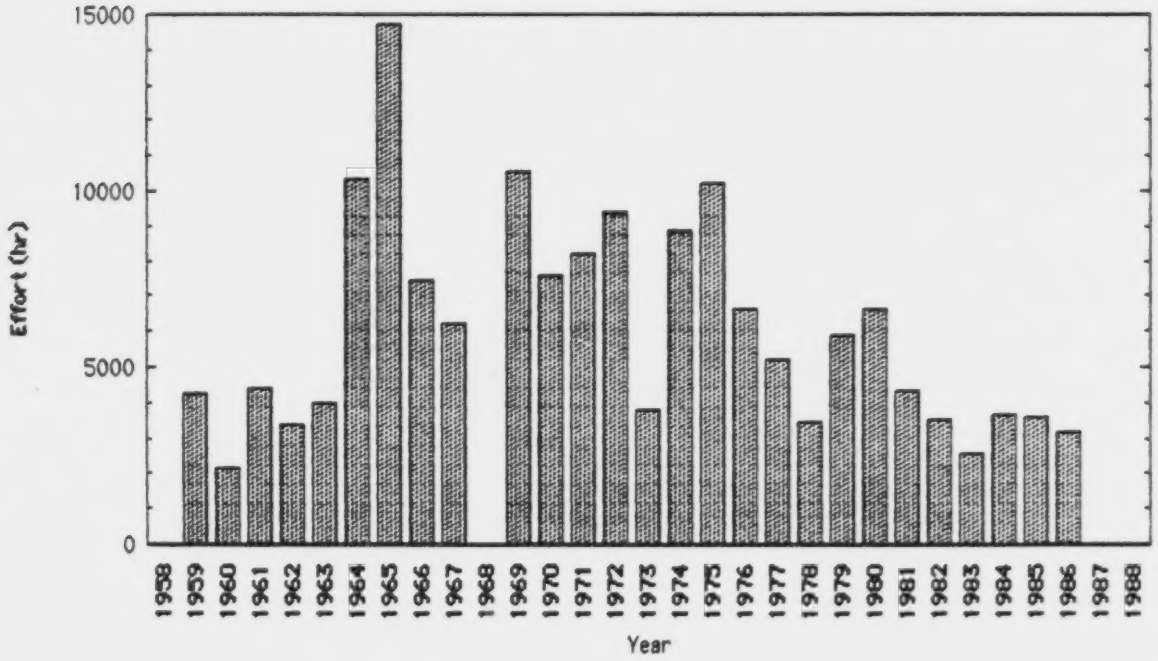

Figure 6: Standardized effort (hr) for redfish in NAFO Division 30, 1959-1987 (1986 is provisional).

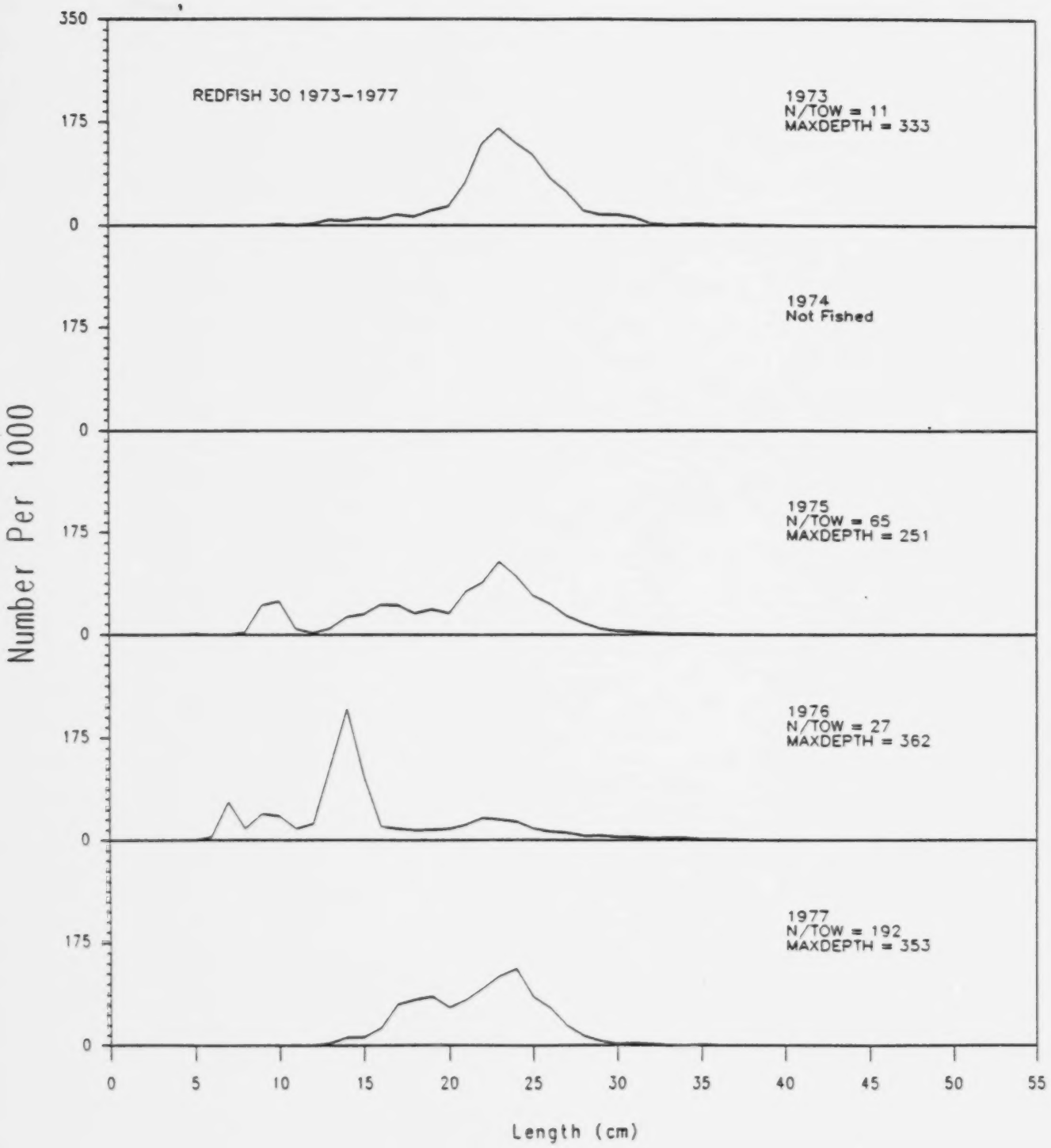

Figure 7: Research length frequencies for redfish from Canadian stratified random surveys in NAFO Division 3O.

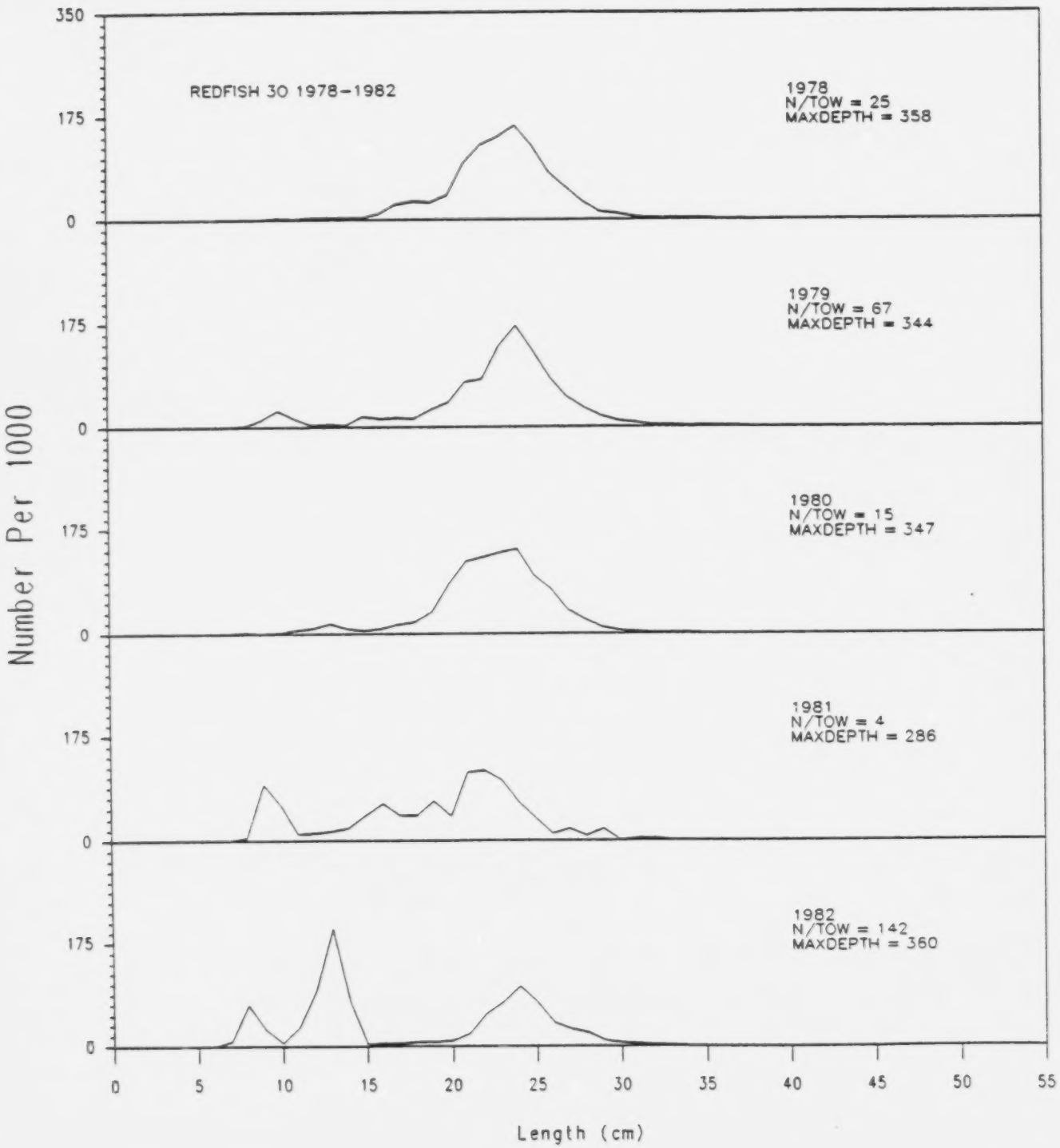

Figure 7: Continued

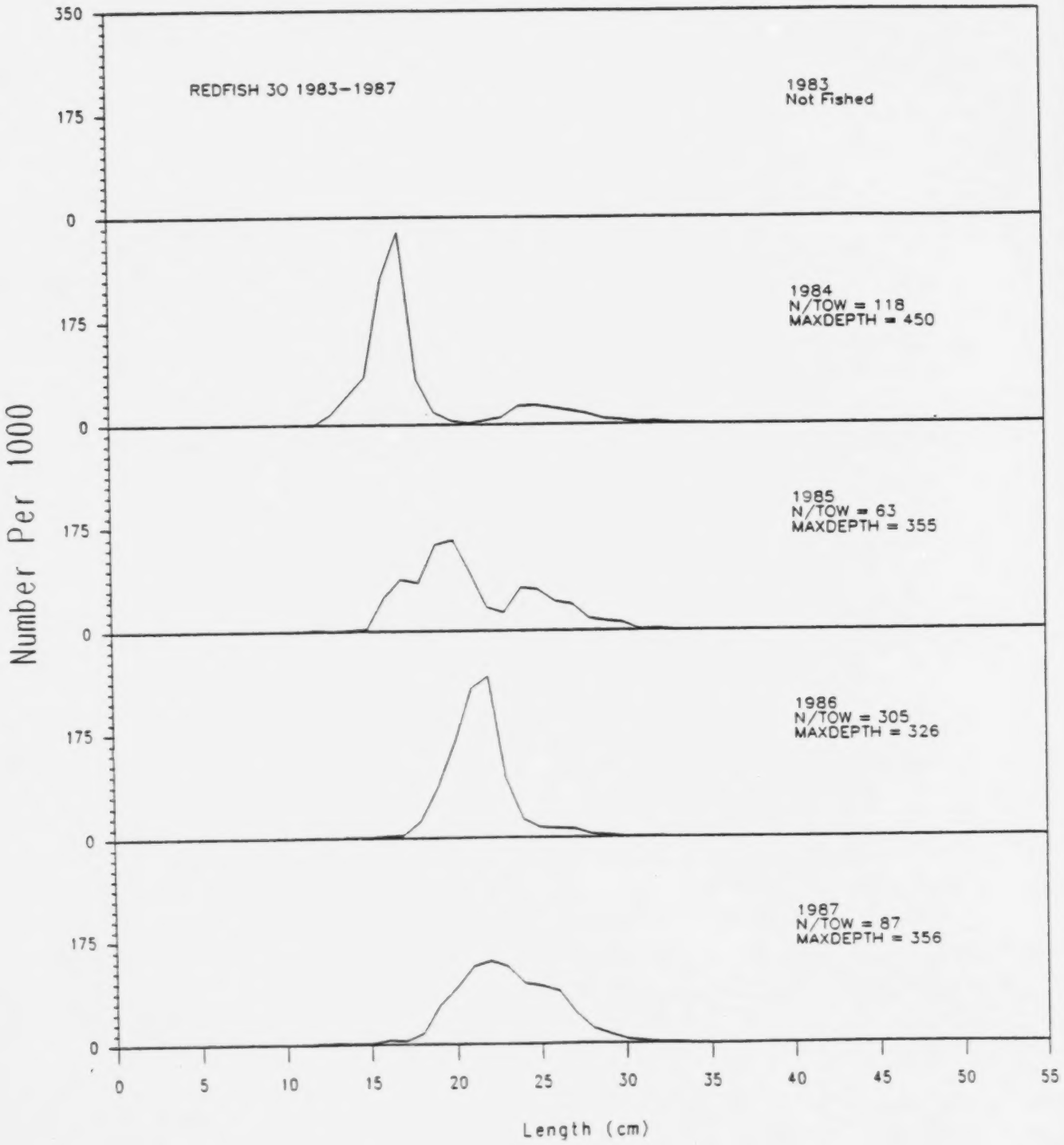

Figure 7: Continued

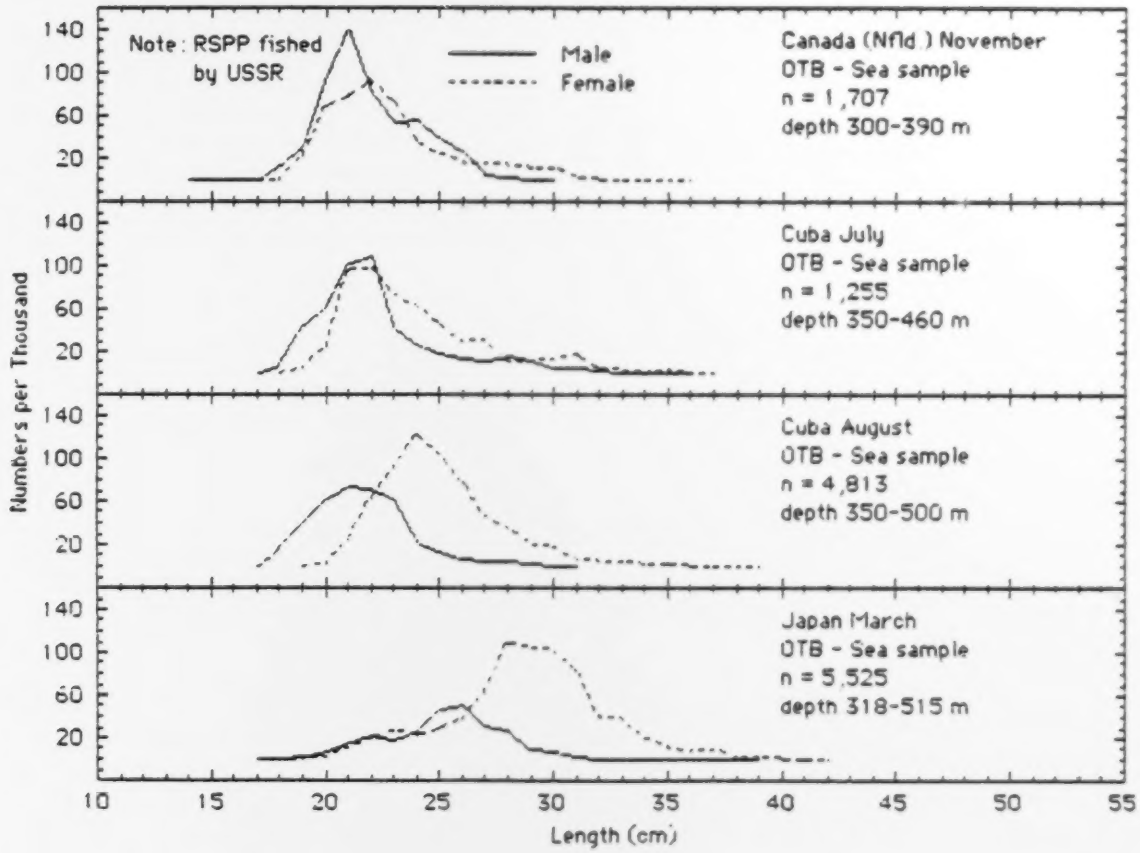

Figure 8 Length frequencies available from the commercial redfish fishery by various countries in NAFO Division 30 in 1987.

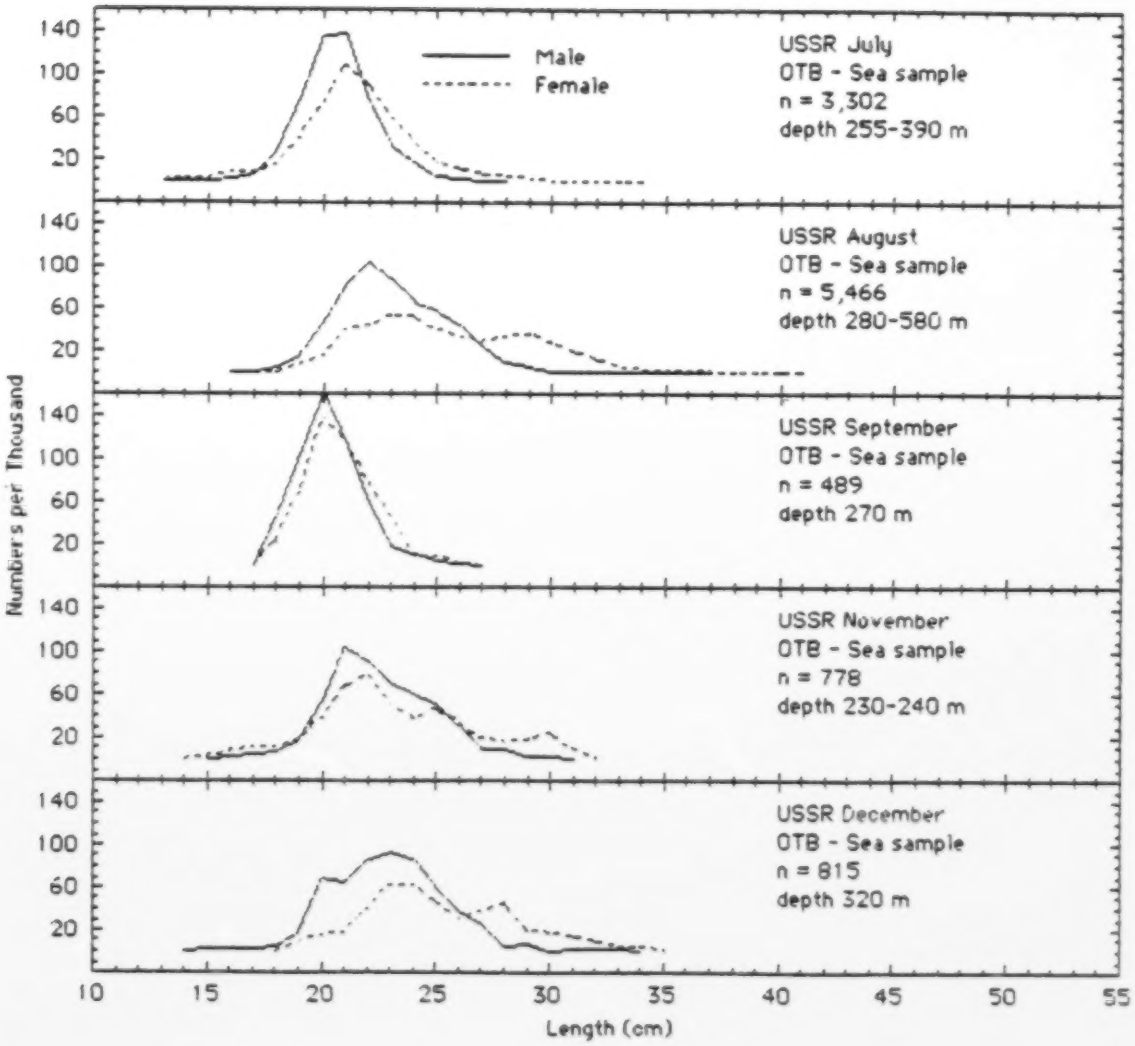

Figure 8 Continued